CHECKLISTS FOR GEOPHYSICS AT HTRW SITES

A. Scope Development Checklist:

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This is a checklist for scoping geophysics at HTRW sites. These are questions the geologist preparing the scope-of-work should ask concerning language in the geophysical surveying task. Not all of these items will be applicable for a given geophysical method or a given site. Many of the items can be left to the Contractor. The Contractor should be allowed flexibility for methodology based on their experience and equipment; however, it is important that the work be quantifiable. Topics that should be included in each scope are indicated by "Required"; those items that are not always necessary but should be considered in each scope are indicated by "Recommended"; and those items that may be considered in some cases are indicated by "Optional".

If the geologist is uncertain of the appropriate survey aspects, consult with the Waterways Experiment Station (WES) or the HTRW Mandatory Center of Expertise (HTRW-MCX) . EPA has an manual on geophysical techniques; "Geophysical Techniques for Sensing Buried Wastes and Waste Migration, EPA 600/7-84-064, June, 1984. The U.S. Geological Survey has developed a geophysical method selection expert system for EPA (U.S.G.S. Open File Report 88-399); an IBM-compatible computer is required. Contact the U.S.G.S or the HTRW MCX for more information.

[1]Waterways Experiment Station, CEWES-GG-F, 3909 Halls Ferry Rd., Vicksburg, MS 39180-6199
[2]Hazardous, Toxic, and Radioactive Waste Mandatory Center of Expertise, CEMRD-ED-TG, P.O.Box 103 DTS, Omaha, NE 68102-0103.

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1. Is objective clear? (Required)

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It is recommended that the objective be discussed with others including the potential Contractor and Corps experts.

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2. Is site described? (Required to extent known)

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This should include all man-made features that may affect the geophysical survey, such as fences, buildings, debris, etc. and natural features such as bedrock outcrops or surface water. Much of this information needs to be provided to the Contractor, if possible. See explanatory text for item B.2.
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a. Are site surface features described?
b. Are site utilities known?

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Include utilities that are present but no longer in use.
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c. Are contaminants/containers described?
d. Are soil types/stratigraphy described?

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Include well logs and locations.
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e. Is site land use described?
f. Ground water depth and flow direction described/estimated?
g. Is topography/accessibility described?
h. If these factors are unknown, is Contractor tasked to determine these?
i. Have references been completely cited and will these be offered to the Contractor?
h. Are potential worker hazards identified?

3. Is the suggested method described? (Optional)

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It is desirable to choose the method before finalizing the contract. If the method is obvious, the scope developer has the background and familiarity necessary to make the choice, and/or if preliminary discussions with the Contractor have led to a consensus on the technique, this item can be specified. Otherwise, the choice can be proposed by the Contractor. The Contractor must have the successful experience in doing the type of geophysical work chosen or must be able to

subcontract a firm that has. If the method is specified in the scope, then the scope must address the issues of calibration, data processing, and quality assurance.
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a. Are the methods suggested appropriate for the site conditions and objectives?
b. Is flexibility provided on actual instrument (unless common or Contractor is known to have it available)? (Recommended)
c. Is more than one geophysical method allowed? (Recommended)

4. Survey scope defined? (Required)
a. Area to be surveyed defined or limits set?
b. Is the resolution of the target or number of line/grid/shotpoint measurement points estimated for bidding purposes and is a rationale provided?

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The number of measurements can be specified. The required resolution of the geophysical survey must be considered and described in the scope. For example, the scope could require the determination of the depth to bedrock +1- 15% on 50-foot centers over a 3.5 acre site. The contrast between the target and the surrounding material should also be considered. These issues can be discussed with the potential Contractor prior to scope finalization.
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c. Is a procedure provided for a test of the method to assure the method can achieve the objective?

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There should be a provision for an "early termination procedure" where the Contractor tests the method(s) to see if the objectives could be achieved. This can be used to eliminate inappropriate methods from the survey or to terminate the contract for the survey before the entire site is covered. The Contractor is still paid for the testing work. Good quality assurance oversight is required to assure the test is performed properly and the decisions made as a result are reasonable. Mobilization costs proposed by the Contractor for the test should not be excessive.
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d. Is forward modeling required for planning the geophysical surveys? (Recommended)

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For certain geophysical methods, such as seismic, modeling of the probable field response based on inferred conditions and target may assist in planning the survey. This may need to be a separate scope task.
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5. Is instrument calibration specified? (Required)
a. Is the instrument drift to be monitored?
b. Is instrument response calibrated at known occurrence of phenomenon of interest or standard?
c. Is the Instrument to be properly calibrated to manufacturer' 5 requirement?

6. Are locations of lines/points to be surveyed in? (Required)

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The level of the survey, reference coordinate system should be described. Consult with in-house survey section staff, if available, for more information.
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7. Is an evaluation of the need for post-collection processing requested? (Optional)

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Some geophysical methods inherently need office processing, while others are presumed directly quantitative. Even the latter procedures would benefit from geostatistical evaluation that may be best resolved in the office.
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a. Has a data correction for instrument drift requested? (Required)
b. Is digital filtering of data to be evaluated?

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If in-house expertise is not available to evaluate the appropriateness of this requirement, contact WES or the HTRW-MCX.
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c. Is the correlation with "ground truth" to be evaluated? (Recommended)

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The results should be compared to known conditions, if possible. For example, the survey should be tied to an existing well or boring or the geophysical survey could include a known tank location. Anomalies should be confirmed or verified by other field techniques, though this can be performed in a later phase. This would include borings, wells, test pits, etc.
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d. Quantitative interpretation to be done? (Recommended if appropriate)

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This could include quantitative calculation of depth to bedrock, mass of buried metal, etc.
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8. Submittal requirements stated? (Required)

a. Workplan topics listed? Recommend:

Objectives
Site Description/History
Methods/Equipment Proposed and Rationale
Study Area Definition and Measurement Spacing
Preliminary Method Testing and Early Termination Procedures
Instrument Calibration and Quality Control Procedures
Field Progress/Interpretation Reporting
Measurement Point/Grid Surveying
Data Processing
Potential Interpretation Techniques

b. Report topics listed? Recommend:

Objectives
Site Description including survey conditions
Field Methodology
Calibration and Data Quality Evaluation
Data Processing
Results (including sections/maps)
Interpretation
Conclusions

c. Form and content of data recording specified? (Recommended)

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The Government should be provided all data. It is recommended that digital recording be supplemented by paper copy and both magnetic media/paper copy be submitted with report. The record keeping must include a description of visual observations of features of interest to problem, including other features which may indicate site contamination or affect the measurements.
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B. Workplan Review Checklist

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These topics are meant to be used as a checklist of items the Contractor should cover in the workplan. See explanation of topics under Scope Development Checklist.
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1. Are objective stated clearly? (Required)

2. Is site adequately described? (Required)

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If some of the information is not available while the Contractor prepared the plan, this should be stated. For example, nothing may yet be known regarding ground water or site stratigraphy. Previous reports, existing literature, etc. should be provided to the Contractor by the Government or the Contractor should be able to gather the information from simple literature review. The Contractor may be required by other portions of the scope-of-work to provide other site activities that will add to the site data, but the geophysical work is often done as one of the first activities at the site. These topics should only be discussed to the extent that they are at least indirectly related to the geophysical work.
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a. Are site surface features described?
b. Are site utilities known and shown on map?
c. Is the contaminant/container described?
d. Are soil types/stratigraphy described?
e. Is the site land use described?
f. Is the ground water depth and flow direction described/estimated?
g. Is the topography/accessibility described?
h. Is a good site map provided?

3. Is the method described? (Required)

a. Is/Are the geophysical method(s) proposed by the Contractor appropriate for the site conditions and objectives?

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The proposal should include a rationale for the choice of technique, if it was not specified in the scope. USGS Geophysics Expert Program can be used to help evaluate the appropriateness of the proposed method).
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b. Is the equipment make/model and catalog information provided? (Required)

c. Is more than one method proposed (Optional)?

d. Is a detailed description of the sequence of measurement and recording provided?

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This varies drastically for various methods. The emphasis must be on detail - a step-by-step description for each line and measurement should be provided.
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e. Are instrument settings and field filtering techniques adequately described?

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This item is relatively advanced and specifying this is often not necessary. This is particularly applicable for seismic and ground penetrating radar methods. The control settings and filter settings and rationale should be described. If expertise is not readily available in-house for evaluating the proposed item, contact WES or the HTRW MCX.
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f. Is modeling done to plan the survey described?

4. Are the geophysical measurement locations defined? (Required)

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This section refers to the locations of the measurement stations, not the location surveying required to tie the location into the coordinate system.
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a. Is the area to be surveyed defined?
b. Is a rationale providedfor line/grid/shot-point spacing or number of measurement points.

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This should include a discussion of how the proposed number or spacing of points will achieve the objective with the required resolution.
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c. Are lines/grid/shotpoint locations shown on a map

5. Is the instrument performance to be verified and calibrated? (Required)

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This topic must address the issue of quality control. There should be quality assurance oversight performed on the part of the Government to assure that proper calibration and interpretation is performed in the field.
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a. Is Instrument drift (or noise) to be monitored?
b. Will there be attempts to verify instrument response at known occurrence of phenomenon of interest or standard?
c. Has the Contractor described the procedures to test the method for achievement of the required resolution and the basis for early termination?
d. Is the instrument to be properly calibrated to manufacturer' 5 requirement?
e. Is the form and content of field reports to the Government described?

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The Contractor should provide reports from the field on the performance of the survey, including documentation of the interpretations made in the field.
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6. Are the locations of lines/points to be surveyed in? (Required)

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The geophysical measurement stations must be tied to an existing coordinate system to allow the sites to be relocated.
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7. Are possible/required post-collection processing techniques adequately described? (Optional)

a. Is the correction to the data for instrument drift described? (Recommended)

b. Any planned digital filtering of data described? (Optional)

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If in-house expertise is not available to evaluate the appropriateness of this requirement, contact WES or the HTRW-MCX. There are many data processing techniques that can be used for the various data to reduce noise, enhance signals of interest, and facilitate interpretation. These would include band-pass frequency filtering, upward/downward continuation, deconvolution, migration (for seismic), vertical gradient determination, simple moving averaging, or just taking the differences between the measurements taken at different instrument orientations (say for an EM survey).
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c. Correlation with "ground truth" to be evaluated? (Recommended)

8. Are possible interpretation techniques described?

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Interpretation techniques are very dependent on the geophysical technique. The interpretation techniques for seismic refraction are far different than the interpretation for resistivity surveys or magnetics. Refer to geophysical texts or EM 1110-1-1802 Geophysical Exploration.
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a. Are the references for the interpretation techniques provided? (Required, if interpretation discussed)

b. Are sample geophysical signatures of the items/features of interest provided?

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For example, do they show what anomaly should be generated by a drum or tank, or a sample seismic record showing a refraction at the bedrock interface?) (Optional)
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c. Are the theoretical bases for the interpretations described? (Required, if Interpretation discussed)

d. Are procedures for verifying interpretations in the field provided or proposed? (Optional)

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This may include borings, test pits, well installation, etc. This may be outside the scope of the project, and may be handled under other phases of work.
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9. Is a proposed topic list for the final report provided? (Optional)

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This should be similar to the table of contents for the work-plan shown in the scope, but would include information on field changes, actual processing and interpretation techniques used and conclusions and recommendations. It should also include an Executive Summary, a list of personnel involved in the geophysical survey, and appendices containing field data and notes.
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10. General
    a. Is a Table of Contents provided?
    b. Do maps/plans/figures have both north arrow and scale provided, and do they show locations of permanent reference markers?
    c. Are units consistent?

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Consistent units, (e.g. System Internationale [SI]) should be used.
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